

# Interpretable survival models

“survxai” package

Aleksandra Grudziąż, MI<sup>2</sup> Group  
Warsaw, 29.09.2019



# Interpretability

Explanation is an answer to a why-question.



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No mathematical definition :)

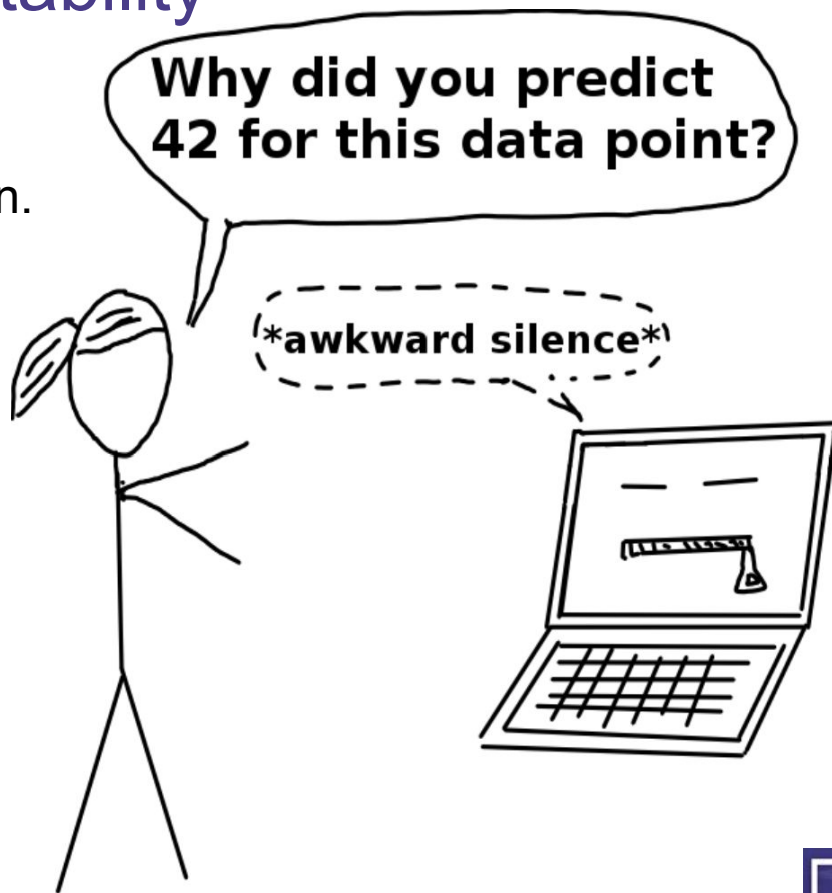


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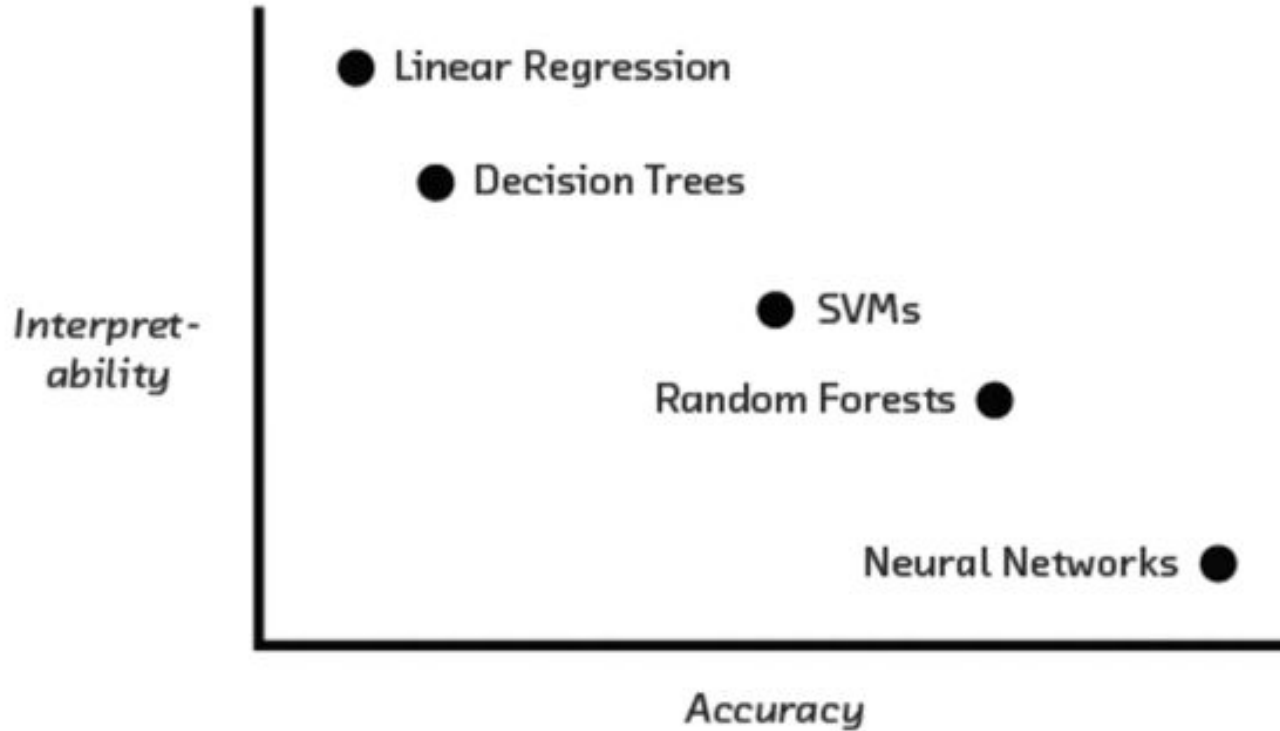
Explaining predictions.



Source:

<https://christophm.github.io/interpretable-ml-book/terminology.html>

# Accuracy / Interpretability trade-off



Source: <https://www.kaggle.com/datacog314/tutorial-machine-learning-interpretability>

# Global and local performance

Global:



# Global and local performance

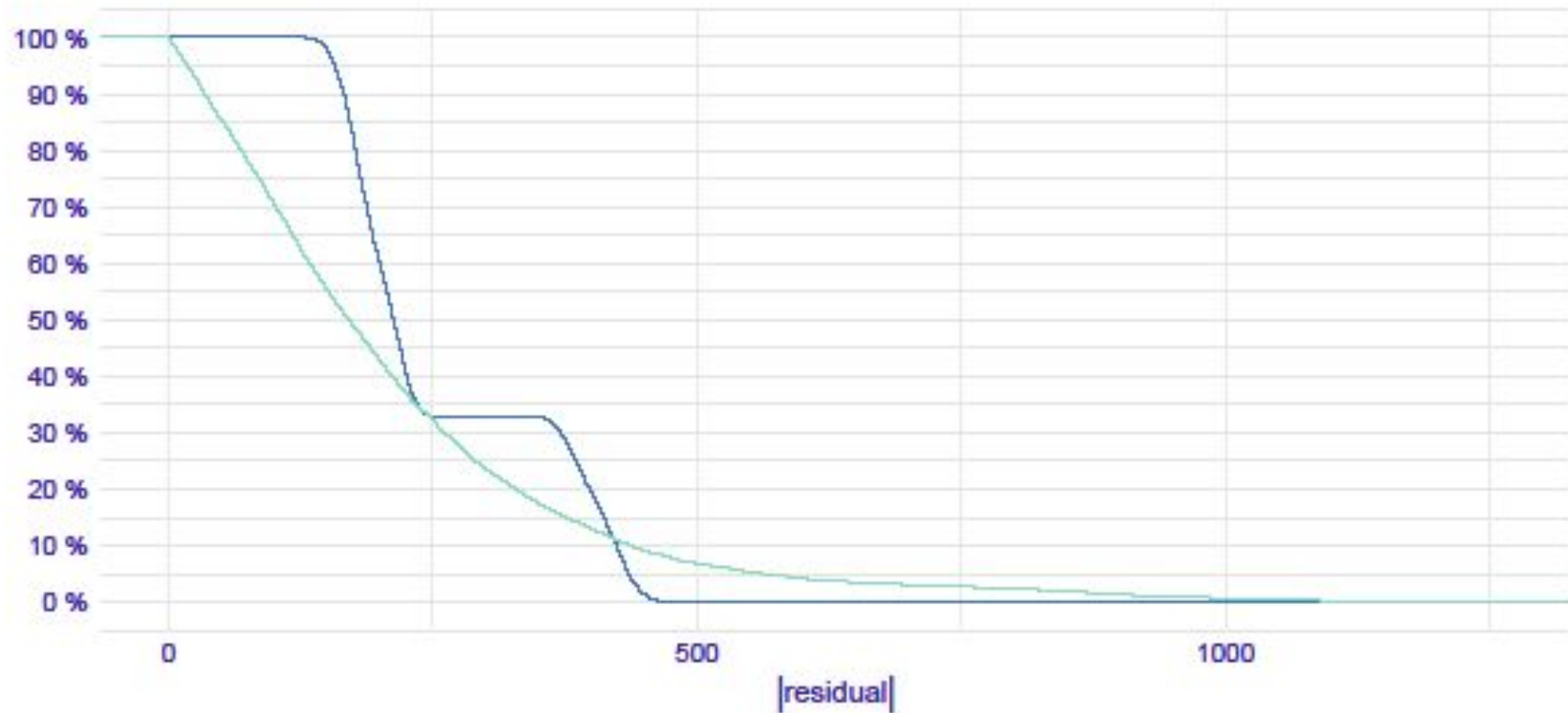
Global:

- model performance



## Distribution of $|\text{residual}|$

Model — lm — randomForest



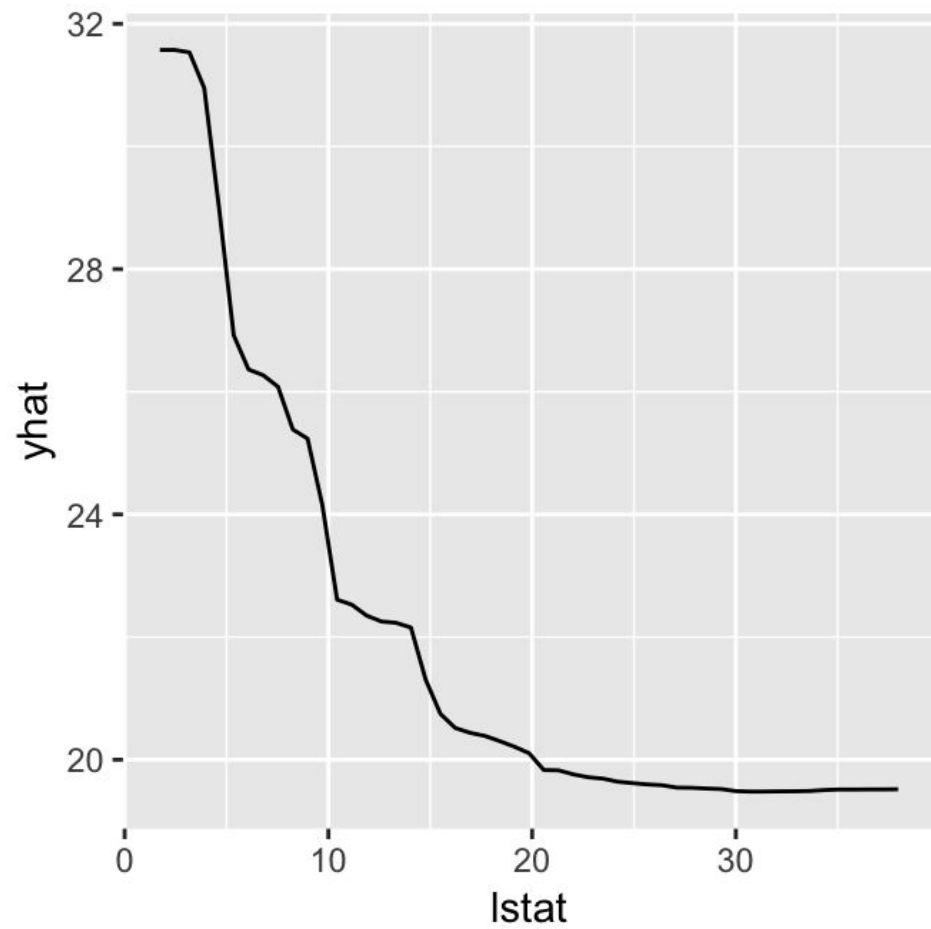
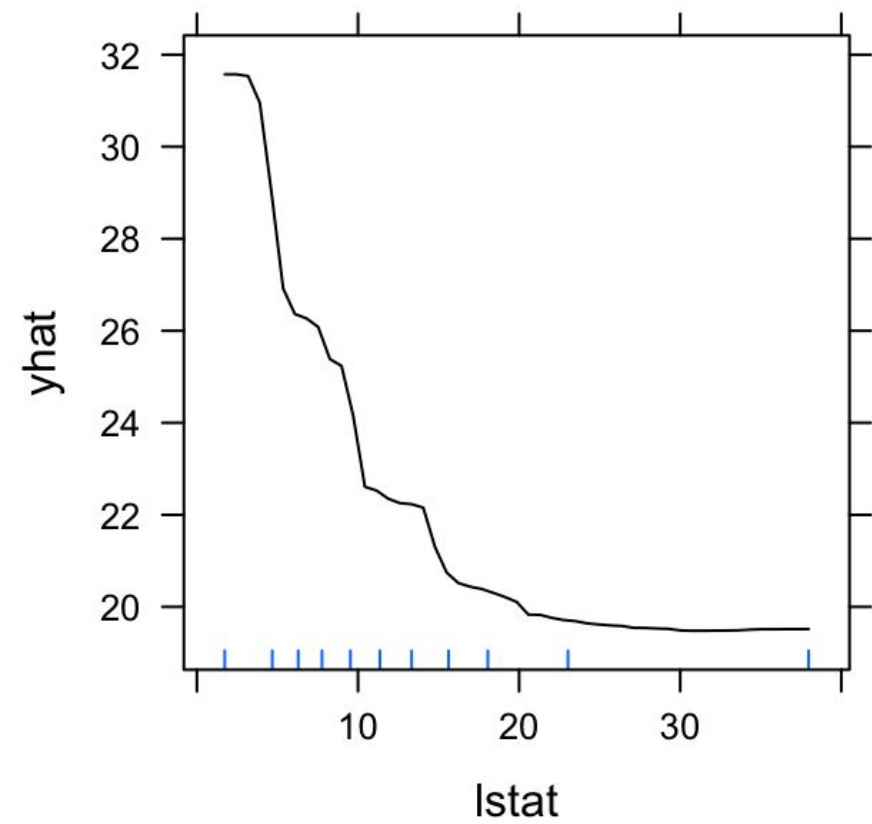


# Global and local performance

Global:

- model performance
- changes in chosen variable





# Global and local performance

Global:

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- changes in chosen variable

Local:



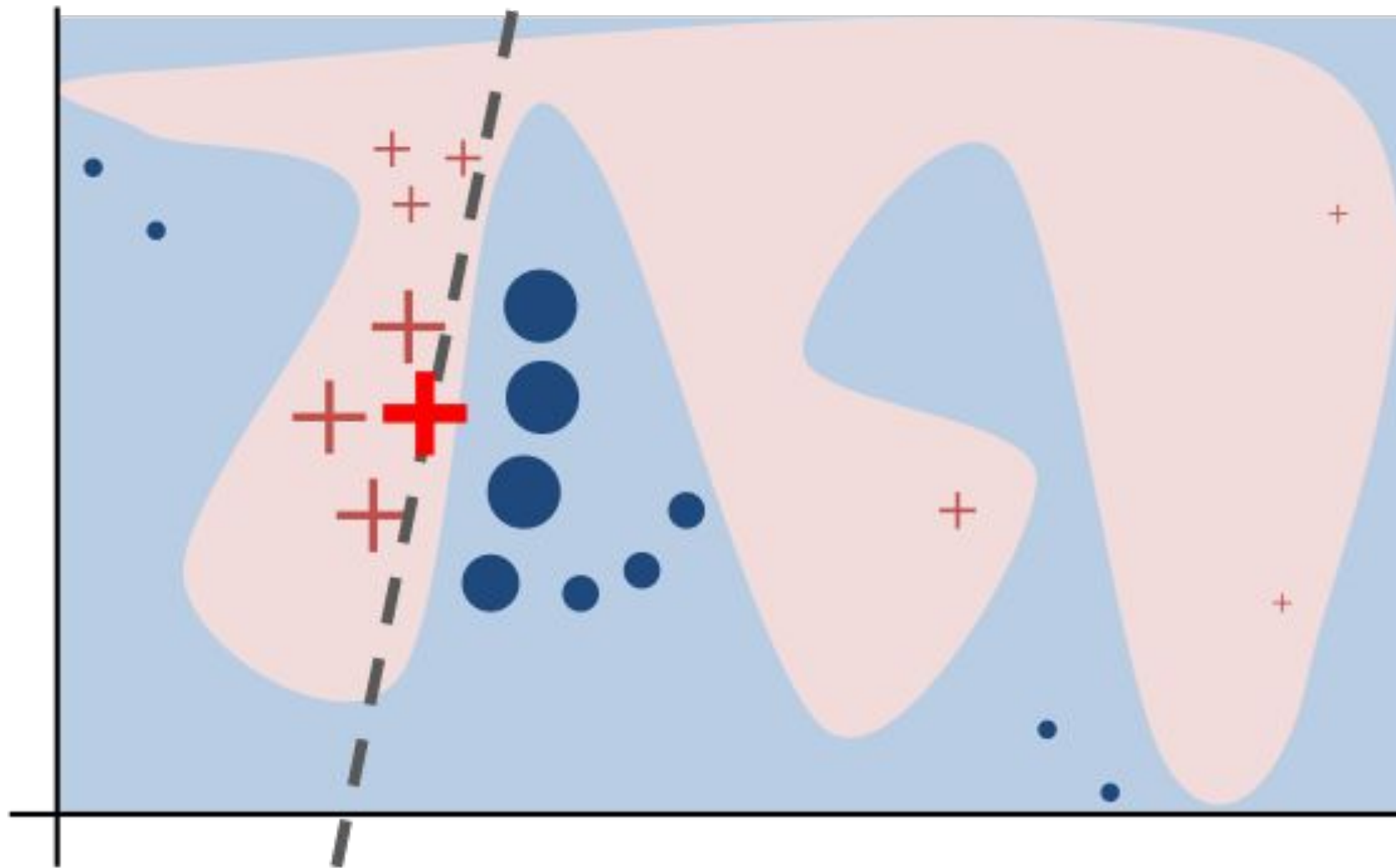
# Global and local performance

Global:

- model performance
- changes in chosen variable

Local:

- changes in new observation, dependency on features



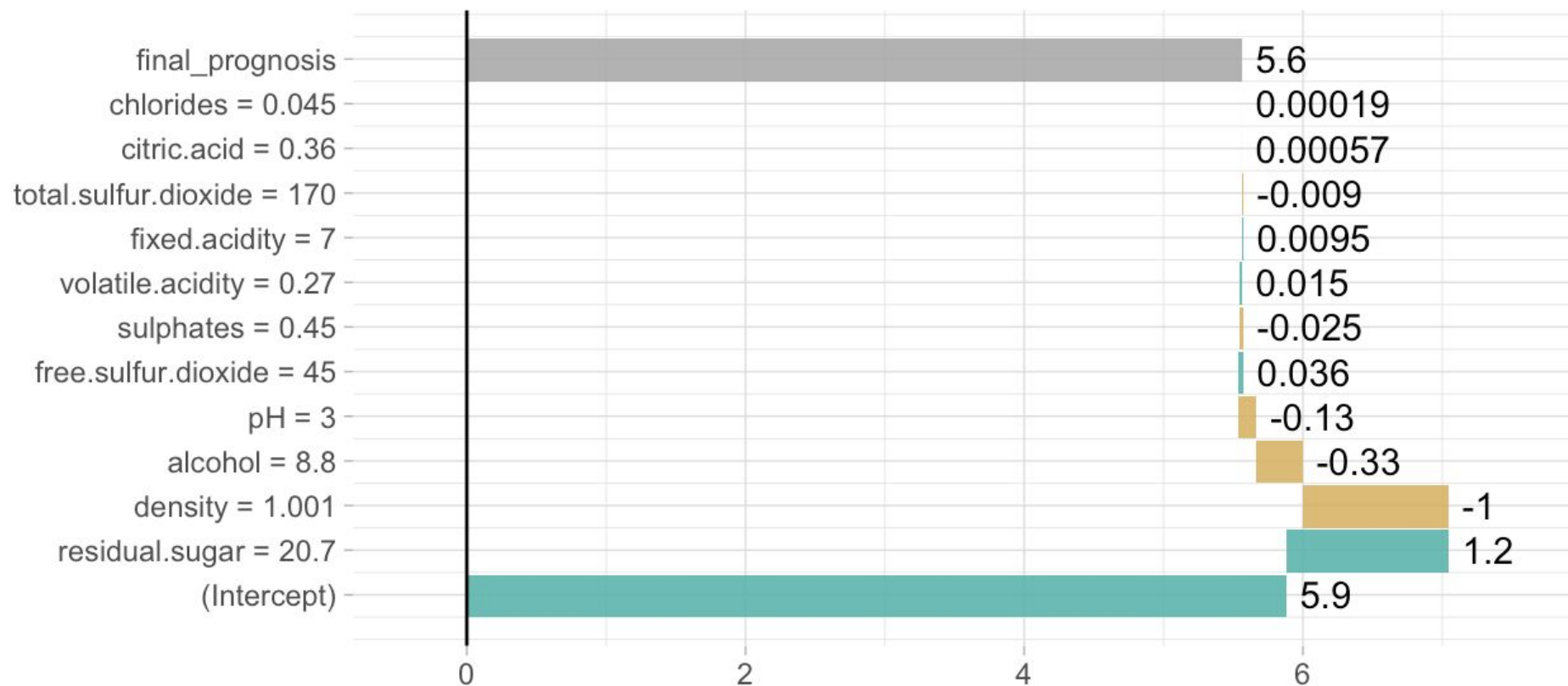
# Global and local performance

Global:

- model performance
- changes in chosen variable

Local:

- changes in new observation, dependency on features
- contribution of variables



# DrWhy.AI universe



ingredients



auditor



shapper



rSAFE



RME



DALEX



vivo



iBreakDown



DALEXtra



modelStudio



# Survival analysis

Examining the time until the event occurs



**Richard, Mr Chenolock, the insurance man,  
is here to determine your life expectancy**

Source: Survival Analysis A Brief Introduction. <https://slideplayer.com/slide/5878133/>

# Survival analysis

Examining the time until the event occurs

Censoring



**Richard, Mr Chenolock, the insurance man,  
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# Kaplan-Meier estimator

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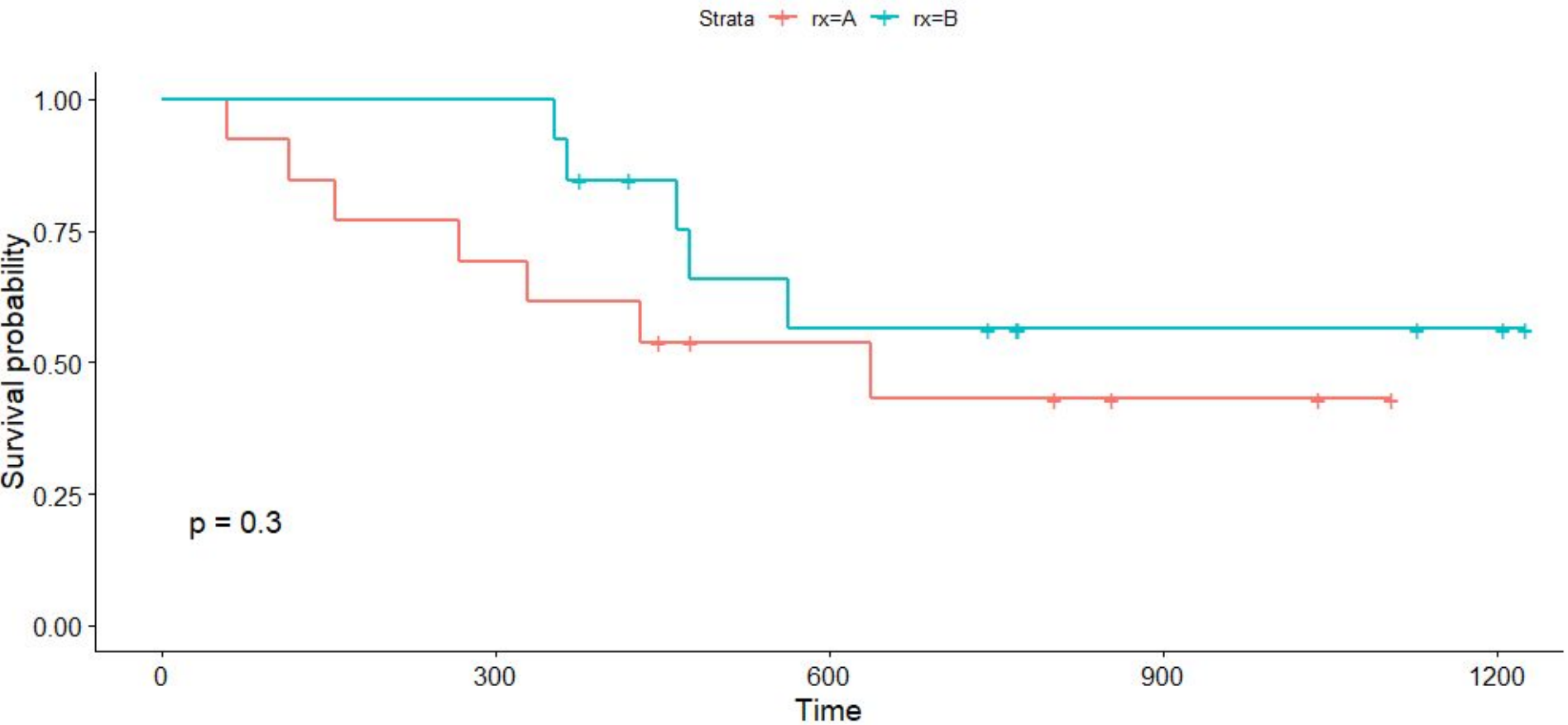
where:

$t_i$  - time of the  $i$ -th event

$n_i$  - the individuals known to have survived (have not yet had an event or been censored) up to time  $t_i$

$d_i$  - number of events at time  $t_i$

# Survival curves





# survxai: an R package for structure-agnostic explanations of survival models

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## Software

- [Review](#) 
- [Repository](#) 
- [Archive](#) 

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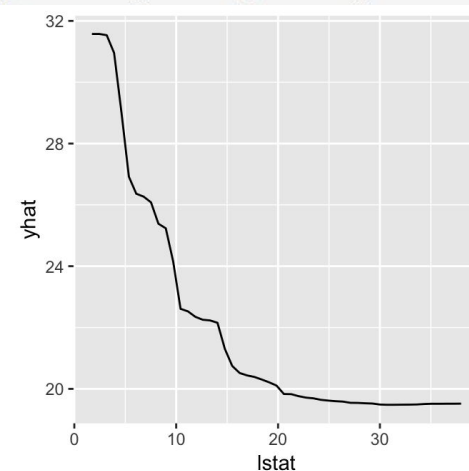
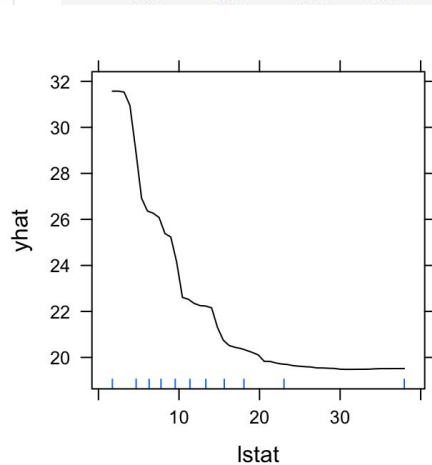
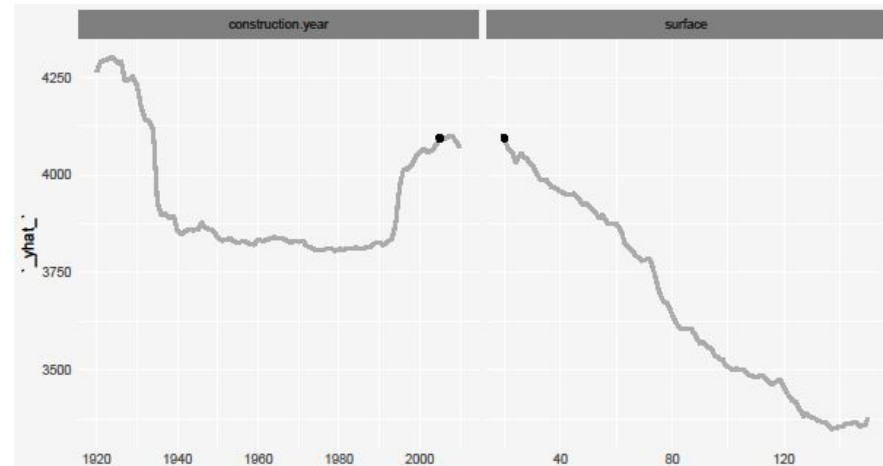
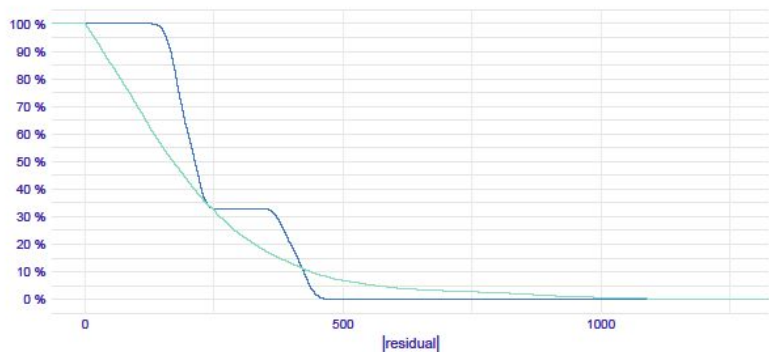
## Introduction

Predictive models are widely used in supervised machine learning. Three most common classes of such models are: *regression models*, where the target variable is continuous numeric, *classification models*, where the target variable is binary or categorical and

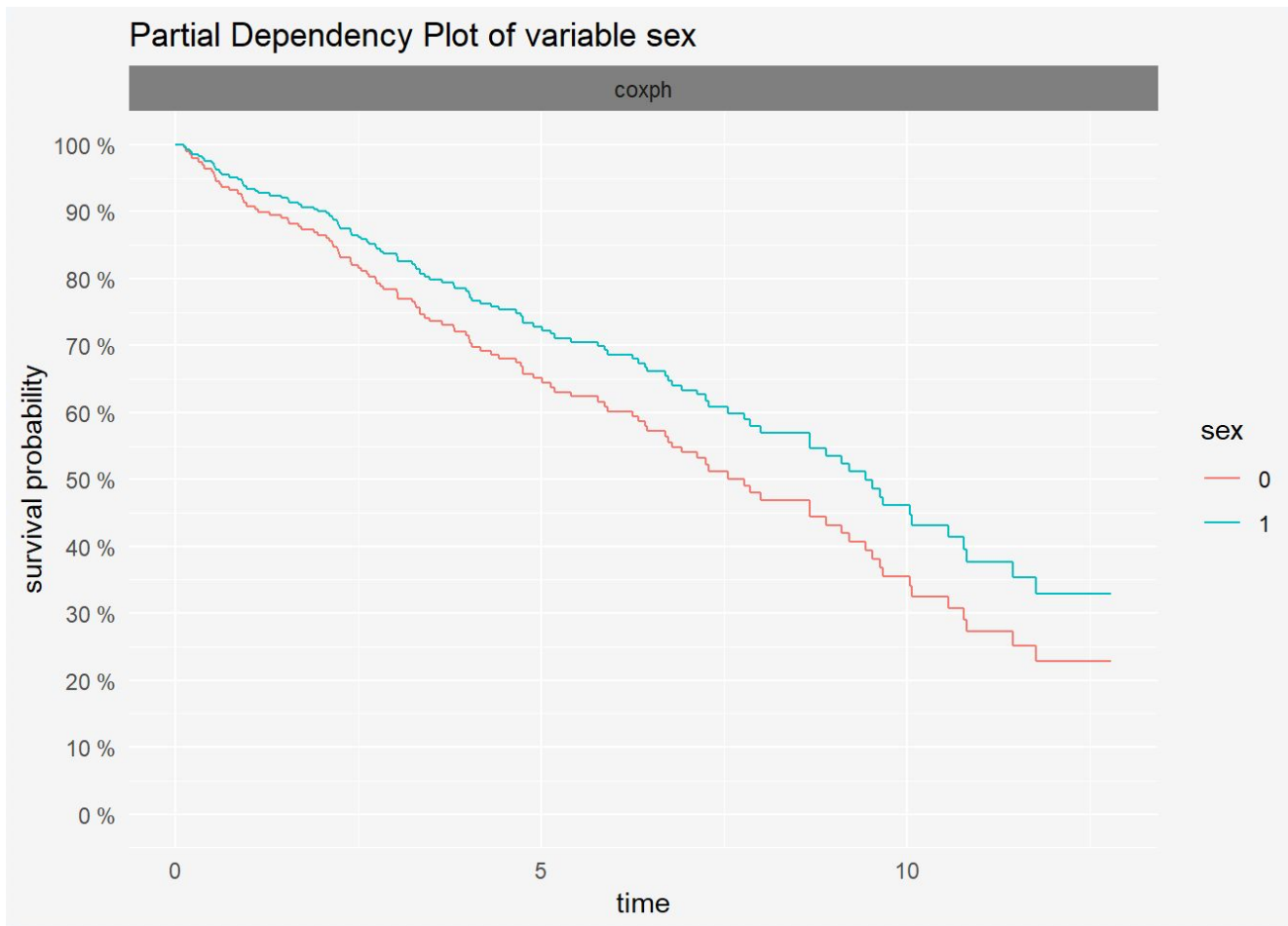
# Interpretability methods

Distribution of |residual|

Model — lm — randomForest

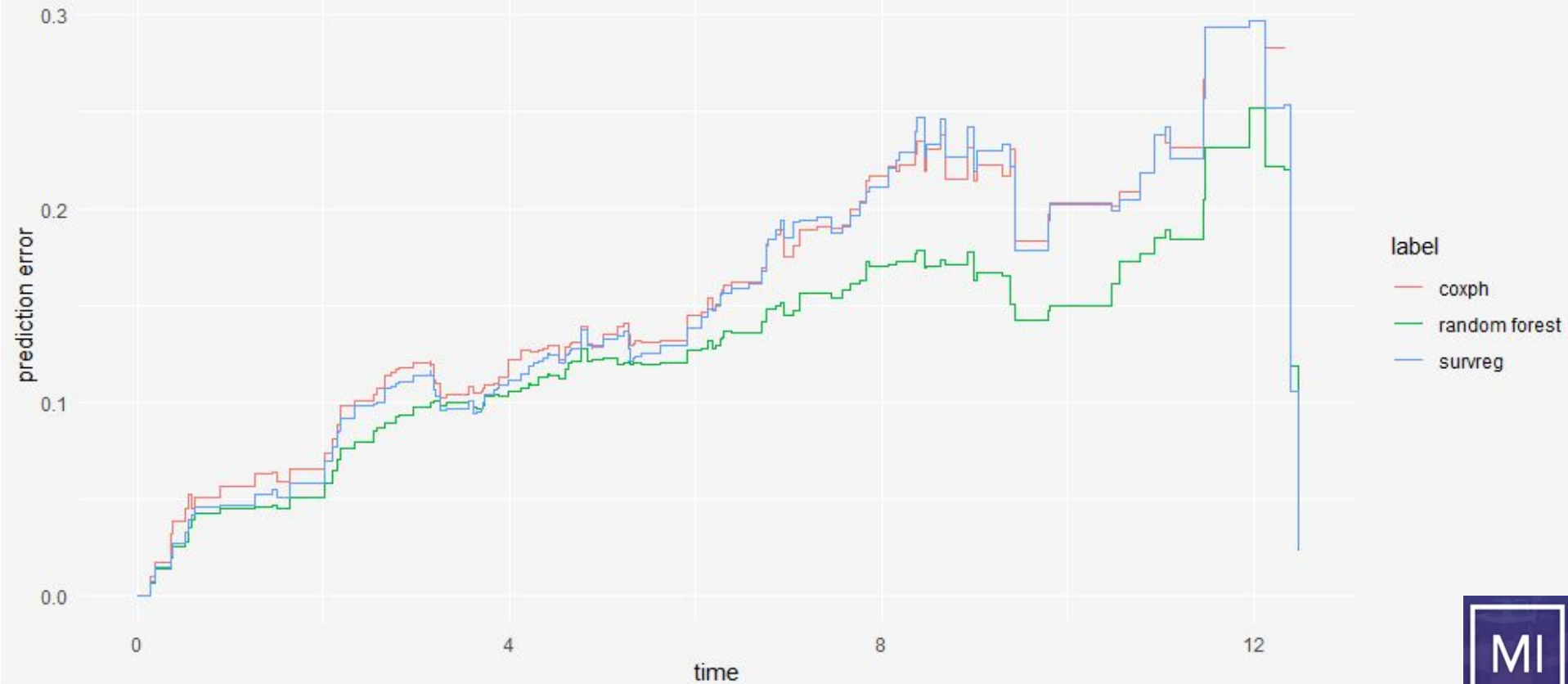


# Partial Dependency Plots

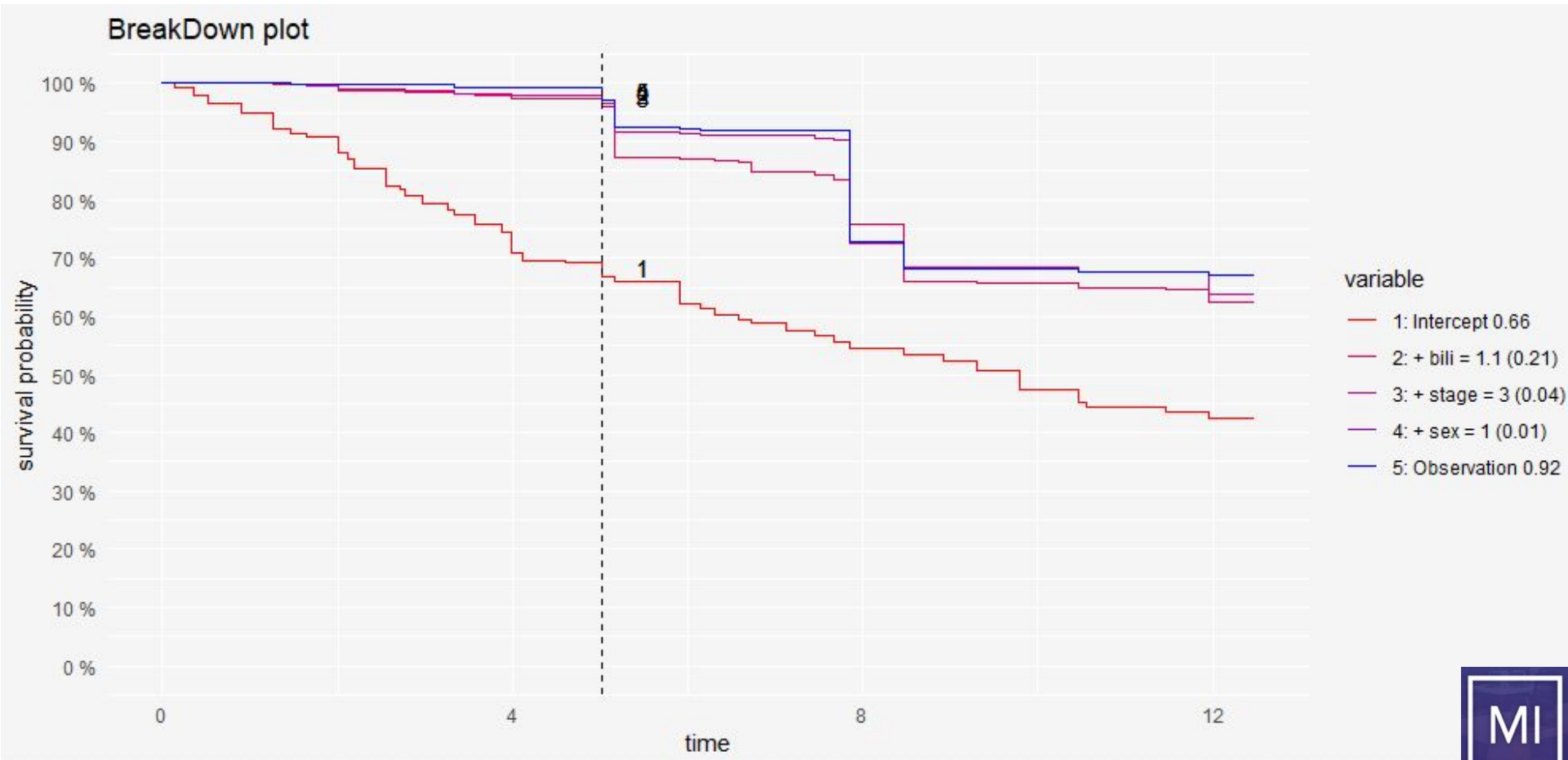


# Model performance

Prediction Error Curve for Brier Score method

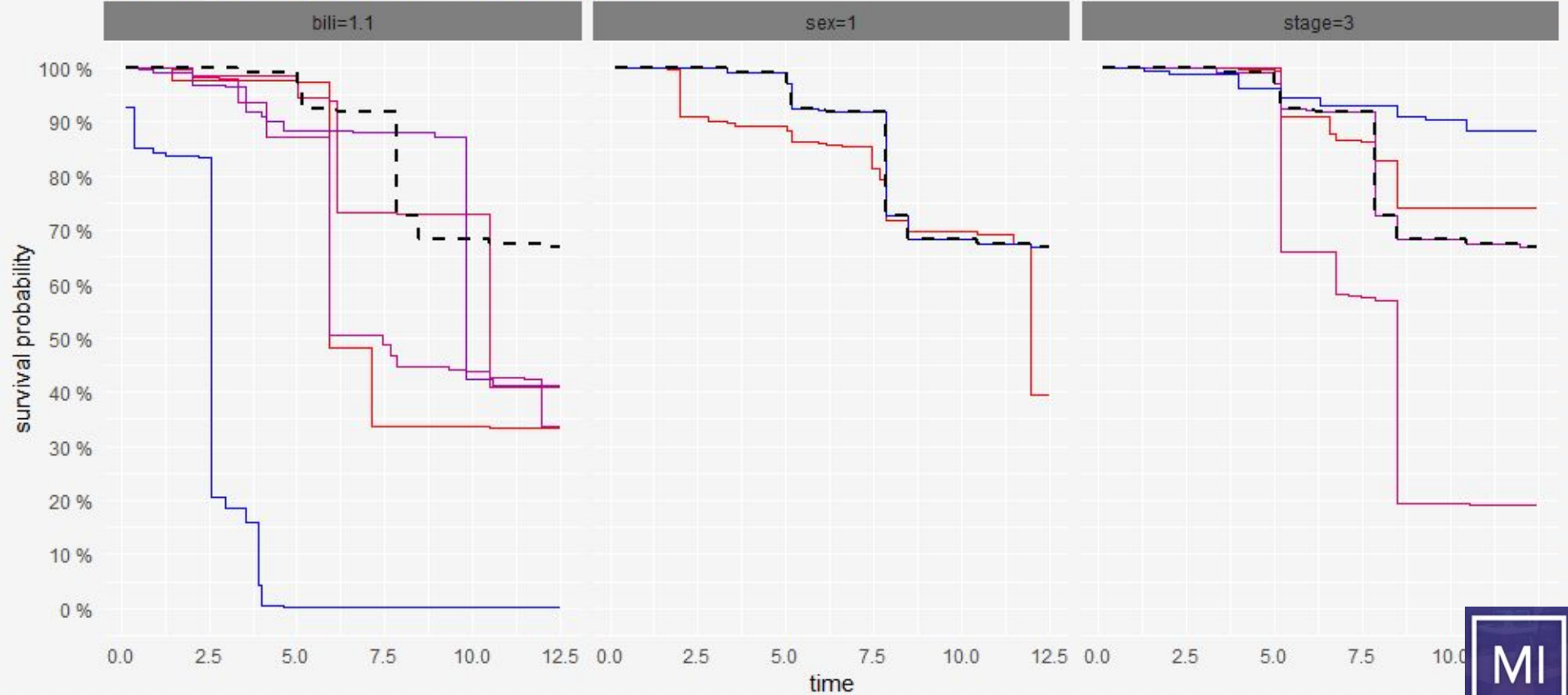


# breakDown



# ceterisParibus - What If? plots

Ceteris paribus plot for random forest model.



# survxai

CRAN 0.2.0 downloads 3092 build passing coverage 95% JOSS 10.21105/joss.00961 cii best practices in progress 98%  
DOI 10.5281/zenodo.1477857

Survival analysis models are used primarily in medicine and churn analysis. Due to many applications, we are witnessing a fast development of a wide range of black-box survival models. Their lack of interpretability makes them unusable for analyzes that require an understanding of the model behavior.

An R package `survxai` is a tool for creating explanations of survival models. For both, complex and simple survival models. It also enables to compare them. Currently, four explanation methods are implemented. We can divide them into 2 groups: local and global.

The read more about the `survxai` package see paper [survxai: an R package for structure-agnostic explanations of survival models](#) in The Journal of Open Source Software.

## Install

```
devtools::install_github("MI2DataLab/survxai")
```

## CheatSheet

### Explainable survival analysis with **survxai**: : CHEAT SHEET



#### Introduction

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#### Local Explanations

**CETERIS PARIBUS**

**Ceteris paribus plot [2]** presents model responses around a single point in the feature space. Ceteris paribus for survival model consists of survival curves around one observation. Each curve represents a different value of the chosen variable. Ceteris paribus plot illustrates how may the survival curve change along with the changing values of the variable.

#### Global Explanations

**VARIABLE RESPONSE**

**Variable response plot** is designed to better understand the relation between a variable and a model output. Variable response plot illustrates how the mean survival curve change along with the changing values of the variable. It is inspired by **partial dependence plots [4]**.

```
vr.rf.sex <- variable_response(surv.rf,"sex")
```



<https://github.com/MI2DataLab/survxai>



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